

UTILIZATION OF OKARA IN BREAD MAKING

G. L. Wickramarathna and P. C. Arampath*

Department of Food Science and Technology, Faculty of Agriculture, University of Peradeniya, Peradeniya.

ABSTRACT

Soyamilk and milk-based products are nutritionally rich, promising food products in local and international markets. Okara, the residue remaining after soyamilk extraction is the main by-product of the soyamilk industry. Currently okara is being utilized as a miscellaneous food ingredient, feed ingredient, or as a source of fertilizer. Although okara is a rich source of nutrients, it has not been fully exploited as an important food source.

This study was conducted to evaluate the proximate composition of okara and to investigate the possibility of utilizing okara in bread making to improve the nutritional quality of bread. Fresh okara was analyzed for proximate composition. Fresh okara was dried in a cross flow cabinet dryer (Pheonix TK – Mini 10) at 60 °C, 20 m/s air flow velocity for 3 hours. The dried okara was ground into flour and sieved [standard test sieve (ASTM), size 20]. Bread was prepared by substituting okara for wheat flour (w/w) at 10, 20 and 30 % levels. Sensory evaluation was conducted by 30 untrained panelists using five-point Hedonic scale on crust colour, crumb colour, taste, odour, appearance, mouth feel and overall acceptability. Results were analyzed by Freedman nonparametric test (MINITAB).

Based on preliminary results, level of substitution was narrowed down to 10, 15, and 20 % and prepared bread was subjected to sensory evaluation. The results revealed that the optimum level of substitution was at 10 % okara flour. Moisture content of fresh okara was 79.7 %. The proximate composition of dried okara was crude fat (11.8 %), crude fiber (6.7 %), crude protein (34.3 %) and total ash (3.6 %). Trypsin inhibitor activity of okara was 6.6 %, 81 % lower than that in whole soyabean. Volume/ mass ratio of the control and okara (10 %) substituted bread were 2.51 and 2.5 respectively. There was a significant difference in crust colour between the control (white) and okara (10 %) substituted bread (red) ($P < 0.05$). The calorific value of okara (10 %) substituted bread (15.9 kJ/g) was higher than that of the control (14.4 kJ/g). Okara consists of high protein and fat, therefore calorific value of okara-substituted bread was higher than the control. There was no significant difference on aerobic spore count of pure wheat flour (10 spores/g) and okara (10 %) substituted wheat flour (7 spores/g) ($P < 0.05$). The sensory qualities and physicochemical characteristics of okara (10 %) substituted bread were not significantly different ($P < 0.05$). It could be concluded that bread substituted up to 10 % with okara was acceptable in terms of sensory properties as compared to control.

INTRODUCTION

Investigation on utilization of underutilized food resources or edible by-products of food industries is a promising alternative to address the aggravating world food problem prevailing in the developing countries including Sri Lanka. Okara is the main by-product of soymilk industries. The nutritive value of okara is comparatively high. Fresh okara is a whitish pulp consists of relatively

* Corresponding author e-mail: pca.mail@pdn.ac.lk

high moisture content (77 %). Dried okara consist of fat (10%), protein (24 %), dietary fiber (52.3 %), ash (4 %) and considerable amounts of vitamins (Rinaldi *et al.*, 2000).

Soybean protein is high in biological value. Soyabean oil contains high amount of essential fatty acids, linoleic (55 %) and linolenic (5 %) (Arora, 1983). Although the presence of biologically active anti-nutritional factors is the main limitation of soya-derived foods (Liener *et al.*, 1980), these factors could be eliminated satisfactorily during various pretreatment and processing conditions. Okara has not been fully exploited as an important food source for human consumption in Sri Lanka. The objective of the experiment was to investigate the possibility of utilizing okara in bread making as a substitute for wheat flour. The research activities were analysis of proximate composition of soybeans and okara, determination of the optimum level of substitution of okara for wheat flour and physicochemical and sensory evaluation of prepared bread and control.

MATERIALS AND METHODS

Fresh okara was obtained from the Food Research Unit, Gannoruwa. Fresh okara was subjected to proximate analysis (AOAC, 1990). The trypsin inhibitor activity in okara and whole soyabean was determined with the modified method of Kakade *et al.*, 1974. Wet okara was dried in a cross flow cabinet dryer (Pheonix TK – Mini 10) at 60 °C, 20 m/s air flow velocity for 3 hours. The dried okara was ground into flour and sieved [standard test sieve (ASTM), size 20]. Bread was prepared (Straight dough method-Matz, 1970) by substituting okara at 10, 20 and 30 % levels into wheat flour. Preliminary tests were conducted with different levels of yeast and sugar within the permitted range in order to obtain better dough development and bread quality characteristics specified in the SLS Bread Specifications (SLS 141: 1992). The best levels of yeast, sugar and shortenings were selected as 2, 3 and 2 % respectively. Bread was subjected to sensory evaluation on crust colour, crumb colour, taste, odour, overall appearance, mouth feel and overall acceptability using five point hedonic scale (Watts *et al.*, 1989). The data was analyzed by Freedman nonparametric test using MINITAB statistical software. Based on the result of the sensory evaluation, range of substitution of okara was narrowed down to 10, 15 and 20 % and prepared bread were tested subjectively to determine the optimum level of substitution.

The procedures described under Methods of Analysis of the Association of Official Analytical Chemists (AOAC, 1990) were followed for proximate analysis. Acid insoluble ash, pH and volume/mass ratio were determined (SLS:141,1992 Bread Specification). Crust and crumb colour were measured with colour difference meter (ZE-2000 Nippon Denshuku). Calorific value of bread (Bomb Calorie meter, Modified Yoshida-type, Model 1013-B) was determined and aerobic spore count of flour was taken (Vas, 1962).

RESULTS AND DISCUSSION

Fresh okara had a moisture content of 79.67 %. Proximate analysis revealed that a considerable amount of nutrients retain in okara after extraction of soymilk (Table 1). Trypsin inhibitor activities of whole soyabean and okara were significantly different ($P < 0.05$). In okara, trypsin inhibitor activity has been reduced by 81 % than that of in whole soyabean (Table 2). The reduction of trypsin inhibitor activity in okara may have resulted due to pretreatments (soaking, blanching and boiling) applied during the soymilk extraction process.

Table 1**Proximate composition (% Dry basis).**

Sample	Moisture	Crude fat	Crude fiber	Crude protein	Total ash
Whole soyabean	12.32	19.83	4.83	42.49	4.67
Okara flour	11.56	11.82	6.66	34.33	3.55

Table 2**Trypsin inhibitor activity.**

Sample	No of trypsin units	No of trypsin units inhibited	% Inhibition
Control	59.7		
Whole soyabean	39.1	20.6	34.53 ^A
Okara	55.79	3.91	6.56 ^B

Means followed by the same letter/s in the same column are not significantly different ($P = 0.05$).

There was no significant difference in aerobic spore count of the control wheat flour (10 spores/g) and wheat flour with okara flour at 10 % level (7 spores/g) ($P < 0.05$). According to the sensory evaluation, the quality attributes of okara (10 %) substituted bread (crumb colour, crust colour, taste, overall appearance, mouth feel and overall acceptability) were not significantly different ($P < 0.05$) except for odour (Fig. 1). Okara (10 %) substituted bread was evaluated as satisfactory when compared to the SLS 141:1992 Bread Specifications (Table 3). The moisture content (37.74 %) of okara (10 %) substituted bread was observed to be below the maximum moisture content (40 %) specified by SLS 141-1992 Bread Specification. Crude fat, crude fiber, crude protein and total ash contents have increased in okara (10 %) substituted bread by 34.1, 40.0, 16.4 and 10.7 % respectively. pH (5.41) of the aqueous extract of the bread was within the specified range (pH 5.3-6.0) in SLS 141:1992 Bread Specifications. Volume/ mass ratio of the control and okara (10 %) substituted bread were 2.51 and 2.508 respectively. These values exceeded the minimum volume/mass ratio, 2.5 specified in SLS 141:1992 Bread Specification (Table 3).

There was a significant difference in crust colour [whiteness (l) and redness (a)] between the control and okara (10 %) substituted bread. A slightly dark crust colour was observed in okara (10 %) substituted bread than that of control. This may be due to the presence of high amount of protein in okara (10 %) substituted bread, which enhanced Maillard reactions responsible for brown colouration (Kent, 1983). Although there was no significant difference in crumb colour, more whitish crumb colour was observed in the control. Since soyabean contains high amount of carotenoid pigments, reduction in 'l' value and increase in 'b' value (yellowness) were observed in okara-substituted bread. The okara (10%) substituted bread was found to have a higher calorific value (15.89 kJ/g) than that of the control bread (14.37 kJ/g). Since okara contains high protein and fat, it is evident that okara-substituted bread has higher calorific value than the control.

Table 3
Physico-chemical characteristics and proximate composition of bread.

	Bread (Control)	Bread (10% Okara)	SLS 141:1992 specification
Moisture	35.81%	37.74 %	40 % (Max)
Acid insoluble ash	0.067%	0.071%	0.1% (Max)
PH	5.40	5.41	5.3 0– 6.00
Volume/ mass	2.510	2.508	2.500
Calorific value	15.89 kJ	14.57 kJ	—
Crude fat	2.31%	3.10%	—
Crude protein	8.37 %	9.74 %	—
Crude fibre	0.10%	0.14%	—
Total ash	1.78%	1.97%	—

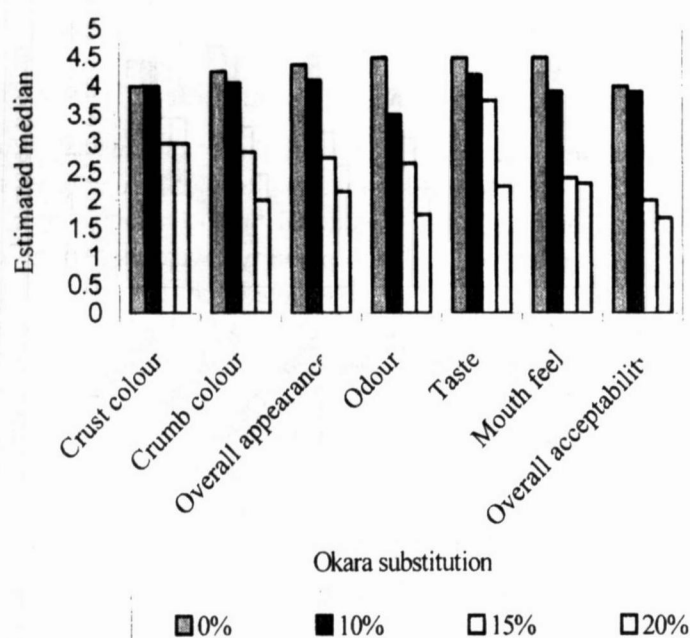


Figure 1. Estimated medians of sensory attributes of okara substituted bread (Hedonic scale: 1=Disliked extremely, 2=Disliked moderately, 3=Neither liked nor disliked, 4=Liked moderately, 5= Liked extremely)

CONCLUSIONS

Okara is a rich source of nutrients that could be utilized in bakery industry. The sensory attributes and physico-chemical characteristics of okara-substituted bread at 10 % level were not significantly different to that of the control wheat bread ($P < 0.05$). Therefore okara could be utilized to improve the nutritional quality of bread. The okara substitution in bakery industry would be

beneficial in reducing the usage of wheat flour and also overcome the waste disposal problem prevailing in the soyamilk industries.

REFERENCES

AOAC, (1990). Official methods of analysis, 15th Edn. Association of Official Analytical Chemists, Washington, DC.

Arora, S.K. (1983). Chemistry and Biochemistry of Legumes. Edward Arnold Ltd, London. Pp 201-287.

Rinaldi, V.E.A., Ng, P.K.W. and Bennik, M.R. (2000). Effects of Dietary Fibre and Isoflavone Contents of Wheat Extrudates Enriched with Okara. *Cereal Chemistry*. 77 (2): 237-239.

Kakade, M.L., Simons, N.R. and Liener, I.E. (1974). Determination of Trypsin inhibitor of Soya Products. A Collaborative Analysis of an Improved Procedure. *Cereal Chemistry*. 51: 376-382.

Kent, N.L. (1983), Technology of cereals, 3rd Edn, Pergman Press Ltd. Oxford, England. Pp 133-144.

Liener, I.E. and Kakade, M.L (1980). Protinase Inhibitors of Plant Food Stuffs, 2nd ed. (I.E. Liener Ed), Academic press, New York. Pp 7-77.

Matz, S.A. (1970). Cereal Technology. AVI Publishing Company INC. Westport, Connecticut, USA. Pp 43-91.

SLS 141: Bread Specification (1992), Sri Lanka Standard Institute, Colombo. Sri Lanka.

Vas, K. (1962). Az elelmisszeripari mikrobiologia nehany altalanos problemaja (Some General Problems in Food Industrial Microbiology. Manuscript). Felsoktatasi Jegyzetlato Yallalat, Budapest.

Watts, B.M., Ylimaki, G.C., Jeffery, L.E. and Elias, L.G. (1989). Sensory Tests. Description and Application. International Development Research Congress, Canada. Pp 54- 86.